INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

MODELS
LGS-5-5-C-OV-R — LGS-5-28-C-OV-R

MP MASTER
MA28359

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

MODELS
LGS-5-5-C-OV-R — LGS-5-28-C-OV-R

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to models LGS-5-5-C-OV-R through LGS-5-28-C-OV-R unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, L.I. N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LGS-5C

TABLE OF CONTENTS

Section	Page
SPECIFICATIONS AND FEATURES	1
THEORY OF OPERATION	4
OPERATING INSTRUCTIONS	6
Basic Mode of Operation	6
Connections for Operation	6
Supply Load Connections	6
Operation After Protective Device Shutdown	7
MAINTENANCE	8
General	8
Opening Unit for Trouble Shooting and Repair	8
Trouble Analysis	8
Checking Transistors and Capacitors	8
Printed Circuit Board Maintenance Techniques	8
Trouble Chart	9
Performance Checks	11
Adjustment of Calibration Control R125	11
SERVICE	12
PARTS ORDERING	12

SPECIFICATIONS AND FEATURES

DC OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

MODELS	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	71°C
LGS-5-5-C-OV-R	5 ± 5%	35.0	31.0	25.0	16.5
LGS-5-6-C-OV-R	6 ± 5%	29.0	26.0	21.0	14.0
LGS-5-12-C-OV-R	12 ± 5%	15.0	13.5	10.0	7.0
LGS-5-15-C-OV-R	15 ± 5%	13.0	11.0	8.0	5.6
LGS-5-20-C-OV-R	20 ± 5%	10.5	9.0	7.0	4.5
LGS-5-24-C-OV-R	24 ± 5%	8.5	7.5	6.0	3.9
LGS-5-28-C-OV-R	28 ± 5%	7.5	6.8	5.4	3.5

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation ..... 0.1% line or load with input variations from 20.5-32 or 32-20.5 volts DC and load variations from no load to full load.

Ripple and Noise ..... 10mV RMS, 35mV peak-to-peak for LGS-5-5-C-OV-R, -6-C-OV-R models; 15mV RMS, 100mV peak-to-peak for LGS-5-12-C-OV-R, -15-C-OV-R, -20-C-OV-R, -24-C-OV-R, and -28-C-OV-R with either positive or negative terminal grounded.

Temperature Coefficient ..... Change in output voltage 0.03%/°C max.

Remote Programming

External Resistor ..... Nominal 1000 ohms/volt output.

Programming Voltage ..... One-to-one voltage change.

Remote Sensing ..... Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

DC INPUT — 20.5-32 VDC. Input power: 335 Watts*. Input current: 16.3 Amps*

*With output loaded to full current rating and input voltage 20.5 VDC.

INPUT FUSE — Fuse F1 protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

INPUT SURGE PROTECTION — Automatic electronic circuit shuts down inverter operation protecting the power supply against excessive input voltage. The unit can withstand input surges of 800 volts for 10 microseconds, 80 volts for 3 milliseconds, or 50 volts for 1 second. Input surge protection trip-point is between 34 and 45 volts DC.

INPUT POLARITY PROTECTION — Models LGS-5-5-C-OV-R through LGS-5-28-C-OV-R are protected against reversal of input polarity.

OVERLOAD PROTECTION

Thermal ..... Thermostat resets automatically when overtemperature condition is eliminated.

Electrical ..... Automatic electronic current limiting circuit, limits output current to a preset safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

OVERVOLTAGE PROTECTION — All LGS-5 models include fixed built-in overvoltage protection circuits which prevent damage to the load caused by excessive power supply output voltage. See table below for overvoltage protector firing ranges.

MODEL	OVERVOLTAGE PROTECTOR TRIP-POINT RANGE (VOLTS)
LGS-5-5-C-OV-R	6.3 — 6.9
LGS-5-6-C-OV-R	7.1 — 7.7
LGS-5-12-C-OV-R	13.3 — 14.1
LGS-5-15-C-OV-R	16.5 — 17.5
LGS-5-20-C-OV-R	22.1 — 23.5
LGS-5-24-C-OV-R	26.5 — 28.1
LGS-5-28-C-OV-R	30.9 — 32.9

INPUT AND OUTPUT CONNECTIONS — Terminal blocks on front of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non operating) — -55°C to 85°C

FUNGUS — All LGS-5 power supplies are fungus inert.

VDC ADJ. Control — Voltage adjust control permits adjustment of DC output over entire operating range.

PHYSICAL DATA

Size	3-3/16" x 4-15/16" x 15"
Weight	13.5 lbs. net; 15 lbs.-shipping
Finish	Gray, FED. STD. 595 No. 26081

MOUNTING — Two surfaces with tapped mounting holes can be utilized for mounting this unit. LGS-5 power supplies can be mounted with Top, Rear, or Right Side facing up. Top, Rear, or Right Side must be in a horizontal plane. Refer to figure 12 for mounting details. Current ratings apply for mounting with Top facing up. Derate current 10% for each ambient temperature given in table I when mounting with Rear or Right Side facing up.

ACCESSORIES

Rack adapters	Rack adapters LRA-10, LRA-11, LRA-13, LRA-14, LRA-15, LRA-16, and LRA-17, used for ruggedized mounting with or without chassis slides, are available.

THEORY OF OPERATION

GENERAL

The Lambda power supply consists of an input circuit; an auxiliary rectifier and filter; a main output rectifier; and a main regulator circuit consisting of timing oscillator, flip-flop, comparator, nor gates, control and current limit amplifiers, and pulse width modulated inverter.

The circuit arrangement is shown in block diagram form in figure 8. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Input circuit

DC input power is applied to the logic circuitry and to the pulse width modulated inverter via E.M.I. suppression network C11, C12, C13, C7, C16, C14, C15, L4, L5. Fuse F1 protects the power supply against excessive currents due to internal failure.

Pulse Width Modulated Inverter

Positive and negative pulses are provided to the primary of T1 by the alternate conduction of switching transistors Q1, Q3 and Q2, Q4. The duration of these pulses is determined by the conduction time of the switching transistors. This time is determined by the duration of drive pulses applied to the bases of Q101 and Q102 by IC103.

When Q101 is turned on, voltage will be applied to the bases of Q1, Q3 via R103, CR114, R113, and R115 turning Q1, Q3 on. Diode CR118 prevents saturation of Q1, Q3 which would extend turn-off time. When Q101 is turned off, Q1, Q3 turn off.

A similar sequence of events serves to turn Q2, Q4 on and off as Q102 is turned on and off.

Output Circuit

Positive and negative pulses supplied by T1 secondary are rectified by full wave rectifiers CR1, CR2; filtered by filter network C2, L1; and supplied to the output via E.M.I. suppression network C5, C6, C109, C110, L2.

Logic and Control Circuits

IC101 is a free running timing oscillator. The output, pin 3, of IC101 is high for 25 microseconds and low for 3 microseconds resulting in an overall period of 28 microseconds. The output of IC101 is fed into flip-flop IC102. IC102 is triggered by the leading edge of the IC101 output resulting in square waves having periods of 56 microseconds at the Q and $\overline{Q}$ (pins 1 and 2) outputs of IC102. Each square wave serves as one input to one of two nor gates located within IC103. The other input of each gate is provided by internal circuitry within IC103 connected as an amplitude comparator at pin 1 of IC103. Pin 1 of IC103 is controlled by the output of the hybrid control amplifier HC101.

HC101 control output is determined by changes in the output voltage as sensed via L102, voltage control R124 and resistor R119. If the output voltage tends to decrease, current from pin 6 output of HC101 is delayed thereby delaying the charging of C119 and delaying the high input to pin 1 of IC103. This action delays turning off the drive output to Q101 or, as applicable, Q102. When IC101 pin 3 goes low, the voltage at IC103 pin 1 is reset via CR126. The connection from IC101 pin 3 to IC103 pins 5 and 6 via CR127 serves to prevent Q101 and Q102 from being turned on while the timing oscillator is in the low state. This sequence of events is shown in the following truth table:

IC101	IC102		IC103			REMARKS
TIMING OSCILLATOR	FLIP-FLOP OUTPUTS		INPUT	DRIVE OUTPUTS		
Pin 3	Pin 1	Pin 2	Pin 1	Pin 10	Pin 11	
low	low	high	low	low	low	inverter dead period
high	low	high	low	high	low	drive Q101
high	low	high	high	low	low	inverter quiescent period
low	high	low	low	low	low	inverter dead period
high	high	low	low	low	high	drive Q102
high	high	low	high	low	low	inverter quiescent period
low	low	high	low	low	low	inverter dead period

Current Limit Operation

As the load current tends to increase, the inverter current increases, thereby increasing the voltage across R120 via current transformer T2. This voltage is sensed by hybrid control amplifier HC101. The result is the progressive hastening of the current output from HC101 pin 6 and therefore, drive current to Q101 or, as applicable, Q102 is turned off sooner and sooner until the conduction time of the inverter becomes less than 3 microseconds.

As HC101 goes into current limit mode, it begins to draw current at pin 8 via resistors R121 and R122, turning on Q103. This, in turn, turns on Q104. This effectively places C112 in parallel with C118 decreasing the frequency of timing oscillator IC101. This action serves to further limit the output current.

As load impedance approaches a short circuit the load current is held relatively constant.

Overvoltage Circuit Operation

When the output voltage reaches the trip-point of the hybrid overvoltage module, the module fires crow-barring the output of the supply. The current through the module is sensed by current sensor L3. The output of L3 triggers SCR101, crow-barring the logic circuitry and turning the inverter off.

Input Surge Circuit Operation

When input voltage reaches zener breakdown voltage of CR107 (approximately 30 volts) plus reference voltage of HC101 (approximately 7 volts) CR107 begins to conduct. This is sensed by HC101 at pins 4 and 13. When input voltage reaches the trip point level (between 34 and 45 volts), HC101 will shut down inverter operation.

Input Polarity Circuit Operation

If input polarity is reversed, CR5 will conduct, effectively short circuiting the input. This will cause F1 to open.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When the 40°C current rating is exceeded, voltage decreases towards zero and the current at short circuit is held to a safe value.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output or input terminal grounded. Both positive and negative output ground connections are shown in the diagrams for all suggested connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the front of the supply. Apply input power to terminals 1 and 2; always connect the positive lead to terminal 1.

The supply positive output terminal is brought out to terminal 7. The supply negative output terminal is brought out to terminal 6. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 9. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for application with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.ξ mf elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at a nominal 1000 ohms/volt change and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will nominally be minimum output voltage plus 1 volt per 1000 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of the programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 1 ma. minimum.

Alternatively, when supplies with less than 1 ma. reverse current capability are used, a resistor capable of drawing 1 ma. at the minimum programming voltage must be connected across the output terminals of the programming supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LGS-5 power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of SPECIFICATIONS AND FEATURES, for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown. The thermostat shuts down inverter operation only when the temperature of the diode heat sink exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative. F1 will also provide protection against reversal of input polarity.

Overvoltage Shutdown. When the power supply output voltage increases above the overvoltage limit, HC1 will short circuit output of the supply and SCR101 will shut down inverter operation. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the DC input circuit. (refer to TROUBLE SHOOTING CHART)

Input Surge Shutdown. When the input voltage exceeds the trip-point, HC101 will shut down inverter operation. Inverter operation will automatically resume when input voltage falls below the trip-point.

Input Polarity Shutdown. If input polarity is reversed, F1 will open to prevent damage to the power supply.

GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

OPENING UNIT FOR TROUBLE SHOOTING AND REPAIR

Whenever it is necessary to troubleshoot and repair the Lambda LGS-5 power supply, open the unit as follows:

1. Remove cover by removing 20 screws securing cover to chassis. Refer to figure 12 for location of correct screws.

2. Remove 10 screws indicated in figure 10. Two screws shown in bottom view should be removed first to avoid undue strain on printed circuit board.

3. Separated two sections of chassis as shown in figure 11.

4. Power supply components are now accessible for trouble shooting and repair.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 8, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors can be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a commercial heat sink device placed between the component and the solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact, but not covered with solder, it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.

3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

   a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

   b) Dip the wick in liquid rosin flux.

   c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

   d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) DC power of proper voltage is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
1. Zero volts DC output, voltage across C1 reads zero.	Open F1.	Check and replace as necessary. Check input polarity.
2. Same as 1, voltage across C1 is correct, voltage across C104 is zero.	Thermostat S1 closed.	Refer to table 1 of SPECIFICATIONS AND FEATURES for current ratings at given ambient temperature. After allowing time for the power supply to cool, resume operation of the supply.

TROUBLE SHOOTING CHART (Cont.)

Symptom	Possible Cause	Remedy
	SCR101 fired due to OV condition.	Interrupt DC input for 15 seconds. If supply operates normally, a transient has occurred in line or load, check wiring (switches, etc.). If supply fails to reach full output voltage, remove DC input, disconnect +V terminal of HC1, remove load, apply DC power and refer to procedure for: Output Too High "Symptom 4."
	R138 open, CR129, CR130 shorted.	Check and replace as necessary.
3. Same as 1, voltage across C1 and C104 are correct.	Q1 through Q4 open.	Check and replace as necessary.
4. Output voltage too high.	Open sense lead.	Check load and load connections, correct as necessary.
	Defective HC101. Open R119, R124, R130, CR122 — CR125.	Check and replace as necessary.
5. Very low output voltage, voltage across C104 reads correct.	R126,R127 open. HC1, HC101, SCR101 defective.	Check and replace as necessary.
6. High ripple.	Defective HC101.	Replace as required.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 9. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the no load to load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a DC power supply, Lambda model LK-351 or equivalent, to vary the line voltage from 20.5-32 or 32-20.5 volts DC and check the power supply line regulation accuracy on the DVM differential meter.

Use a TVM, John Fluke Model 931B or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R125.

Whenever HC101 or R125 is replaced, and voltage and current indications do not reflect maximum ratings, adjust R125 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove DC input power to the supply.
2. Break seal on wiper of R125 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing connected as shown in figure 3, with no external load, and with DC input of 32 VDC.
4. Turn voltage adjust control until minimum rated output voltage is obtained.
5. Apply load so that output current is 105-110% of 40°C rating for the unit.
6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R125 in CCW direction. Adjust R125 until output ripple frequency decreases sharply. Readjust R125 in CW direction until output ripple frequency increases sharply.
7. After adjustment is completed, remove DC power input to the supply and use glyptol sealant to seal wiper of R125 to resistor housing.
8. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not electronic part, or is not listed, provide a description, function, and location, of the part.

PARTS LIST

The electrical parts located on Lambda models LGS-5-5C-OV-R — LGS-5-28C-OV-R are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common-parts listing.

COMMON PARTS
MODELS LGS-5-5C-OV-R — LGS-5-28C-OV-R

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 3,900 mf -0 + 100%, 75 vdc	CBS-39-137
C3	Cap., elect., 3.9 mf ±10%, 50 vdc	CBN-39-041
C4	Not assigned	
C5, C6	Cap., ceramic, 0.1 mf ±20%, 500 vdc	CDM-10-002
C7	Cap., elect., 3.5 mf -10 +100%, 450 vdc	CBN-35-035
C8	Cap., ceramic, 0.01 mf ±20%, 1,000 vdc	CDL-10-004
C9	Cap., ceramic, 0.001 mf ±20%, 3,000 vdc	CDK-10-014
C10	Cap., ceramic, 0.01 mf ±20%,1,000 vdc	CDL-10-003
C11	Same as C8	
C12, C13	Same as C9	
C14, C15	Same as C8	
C16	Same as C10	
C17, C18	Same as C9	
C19, C20	Not assigned	
C21, C22	Cap., ceramic, 0.002 mf ±10%, 1,000 vdc	CDK-20-003
C101	Not assigned	
C102	Cap., elect., 22 mf -10 +100%, 75 vdc	CBP-22-076
C103	Cap., elect., 3.3 mf ±20%, 35 vdc	CBN-33-019
C104	Cap., elect., 22 mf ±20%, 35 vdc	CBP-22-055
C105, C106	Not assigned	
C107, C108	Same as C10	
C109, C110	Same as C5	
C111	Cap., mylar, 0.022 mf ±10%, 200 vdc	CGL-22-001
C113	Same as C5	
C114 thru C116	Not assigned	
C117	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
C118	Cap., ceramic, 1,800 pf ±2%, 50 vdc	CDK-18-013
C119, C120	Cap., mica, 100 pf ±5%, 500 vdc	CCJ-10-007
C121	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
C122	Not assigned	
C123	Cap., mylar, 0.1 mf ±10%, 80 vdc	CGM-10-006

COMMON PARTS (Cont)
MODELS LGS-5-5C-OV-R — LGS-5-28C-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C124	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C125, C126, C128 thru C131	Not assigned	
C132	Same as C21	
CR3, CR4	Not assigned	
CR5	Rectifier	FBL-00-144
CR101 thru CR106	Rectifier	FBL-00-082
CR107	Rectifier, zener diode	FBM-Z127
CR108	Rectifier	FBL-00-030
CR109 thru CR111	Rectifier	FBL-00-082
CR112, CR113	Not assigned	
CR114	Same as CR101	
CR115	Not assigned	
CR116	Same as CR101	
CR117	Not assigned	
CR118, CR119	Rectifier	FBL-00-105
CR120, CR121	Not assigned	
CR122 thru CR125	Rectifier	FBL-00-103
CR126, CR127	Same as CR101	
CR128	Rectifier, zener diode	FBM-Z155
CR129, CR130	Rectifier, zener diode	FBM-Z166
CR131, CR132	Same as CR101	
CR133	Not assigned	
CR134, CR135	Rectifier, zener diode	FBM-Z167
CR136, CR137	Rectifier	FBL-00-105
F1	Fuse, 25A, 3AB, NORM-BLO	FFJ-25-000
HC101	Hybrid circuit	FBH-00-002B
IC101	Integrated circuit	FBT-00-042
IC102	Integrated circuit	FBT-00-043
IC103	Integrated circuit	FBT-00-044
L2	Choke, output	TCT-062-015
L3	Not assigned	
L4	Choke, EMI	BBA-GS5C-1
L5	Choke, EMI	BBA-GS5C-2
L101	Not assigned	
L102	Choke, EMI	BBA-GS5-4
L103	Choke, OV	BBA-GS5-5
Q1 thru Q4	Transistor, NPN	FBN-L190

COMMON PARTS (Cont.)

MODELS LGS-5-5C-OV-R — LGS-5-28C-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
Q101, Q102	Transistor, NPN	FBN-L177
Q103	Transistor, PNP	FBN-L118
Q104	Transistor, NPN	FBN-L110
R1	Not assigned	
R2	Res., ww, 7.5 ohms ±5%, 10 w	DFN-75-095
R3, R4, R6 thru R9, R11, R12	Not assigned	
R13 thru R16	Res., ww, 0.1 ohm ±5%, 3 w	DLM-10-008
R17 thru R20	Not assigned	
R21, R22	Res., comp., 180 ohms ±5%, 1 w	DGB-1815
R23 thru R26	Same as R13	
R101, R102	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021
R103, R104	Res., comp., 91 ohms ±5%, 1 w	DGB-9105
R105, R106	Res., film, 220 ohms ±1%, ½ w	DCR-22-005
R107	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701
R108	Res., comp., 1,500 ohms ±10%, ¼ w	DCB-1521
R109	Res., comp., 18,000 ohms ±10%, ¼ w	DCB-1831
R111	Res., comp., 10,000 ohms ±10%, ¼ w	DCB-1031
R112	Res., comp., 4,700 ohms ±10%, ¼ w	DCB-4721
R113 thru R116	Res., film, 20 ohms ±1%, ¼ w	DCP-20-013
R117	Res., film, 15,000 ohms ±1%, ½ w	DCT-15-045
R118	Res., film, 2,210 ohms ±1%, ½ w	DCS-22-112
R120	Res., comp., 10 ohms ±10%, ½ w	DEB-1001
R121	Res., comp., 47,000 ohms ±10%, ¼ w	DCB-4731
R122	Same as R111	
R123	Same as R121	
R125	Res., var., cermet, 2,000 ohms ±20%, 1 w	DRS-20-012
R126	Res., comp., 2.7 ohms ±10%, ¼ w	DCB-27G1
R127	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011
R128	Same as R111	
R129	Not assigned	
R130	Res., ww, 1,800 ohms ±5%, 5 w	DFS-18-026
R131	Res., comp., 1,000 ohms ±10%, 1 w	DGB-1021

COMMON PARTS (Cont.)

MODELS LGS-5-5C-OV-R — LGS-5-28C-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R132	Res., comp., 4,700 ohms ±10%, ½ w	DEB-4721
R133 thru R137	Not assigned	
R138	Res., ww, 390 ohms ±3%, 5 w	DFR-39-105
R139	Not assigned	
R140	Res., ww, 25 ohms ±5%, 3 w	DFP-25-023
S1	Thermostat	FKA-110-026
SCR101	Rectifier, silicon controlled	FBP-00-045
T2	Transformer, current	ABA-GS5C-1
XF1	Fuseholder	HRM-00-009

UNIQUE PARTS

MODEL LGS-5-5C-OV-R

C2	Cap., elect., 45,000 mf -10 +100%, 7.5 vdc	CBT-45-048
C112	Cap., mylar, 0.001 mf ±10%, 400 vdc	CGK-10-009
C127	Cap., mica, 680 pf ±10%, 300 vdc	CGJ-68-006
CR1, CR2	Rectifier	FBL-00-118
HC1	Hybrid circuit	L-20-OV-5
L1	Filter choke	BBA-LGS5-5
R5	Res., ww, 25 ohms ±3%, 5 w	DFP-25-066
R119	Not assigned	
R124	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-020
T1	Transformer	ABA-LGS5C-5

MODEL LGS-5-6C-OV-R

C2	Cap., elect., 45,000 mf -10 +100%, 7.5 vdc	CBT-45-048
C112	Cap., mylar, 0.001 mf ±10%, 400 vdc	CGK-10-009
C127	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006
CR1, CR2	Rectifier	FBL-00-118
HC1	Hybrid circuit	L-20-OV-6
L1	Filter choke	BBA-LGS5-5
R5	Res., ww, 25 ohms ±3%, 5 w	DFP-25-066
R119	Not assigned	
R124	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-020
T1	Transformer	ABA-LGS5C-6

MODEL LGS-5-12C-OV-R

C2	Cap., elect., 19,000 mf -10 +100%, 25 vdc	CBT-19-049
C112	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
C127	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006
CR1, CR2	Rectifier	FBL-00-140
HC1	Hybrid circuit	L-20-OV-12
L1	Filter choke	BBA-LGS5-12

UNIQUE PARTS (Cont.)

MODEL LGS-5-12C-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R5	Res., ww, 50 ohms ±3%, 7 w	DFP-50-067
R119	Res., film, 7,500 ohms ±1%, ¼ w	DCS-75-072
R124	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-020
T1	Transformer	ABA-LGS5C-12

MODEL LGS-5-15C-OV-R

C2	Cap., elect., 15,000 mf -10 +100%, 30 vdc	CBT-15-050
C112	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
C127	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006
CR1, CR2	Rectifier	FBL-00-140
HC1	Hybrid circuit	L-20-OV-15
L1	Filter choke	BBA-LGS5-15
R5	Res., ww, 75 ohms ±3%, 7 w	DFP-75-069
R119	Res., film, 10,000 ohms ±1%, ¼ w	DCT-10-047
R124	Res., var., cermet, 5,000 ohms ±20%, 1 w	DRS-50-020
T1	Transformer	ABA-LGS5C-15

MODEL LGS-5-20C-OV-R

C2	Cap., elect., 10,000 mf -10 +100%, 40 vdc	CBT-10-051
C112	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001
C127	Cap., mica, 100 pf ±5%, 500 vdc	CCJ-10-007
CR1, CR2	Rectifier	FBL-00-145
HC1	Hybrid circuit	L-20-OV-20
L1	Filter choke	BBA-LGS5-20
R5, R10	Res., ww, 220 ohms ±3%, 7 w	DFR-22-117
R119	Res., film, 13,300 ohms ±1%, ¼ w	DCT-13-067

UNIQUE PARTS (Cont.)

MODEL LGS-5-20C-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R124	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-048
T1	Transformer	ABA-LGS5C-20

MODEL LGS-5-24C-OV-R

C2	Cap., elect., 6,300 mf -10 +100%, 50 vdc	CBS-63-134
C112	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001
C127	Cap., mica, 100 pf ±5%, 500 vdc	CCJ-10-007
CR1, CR2	Rectifier	FBL-00-145
HC1	Hybrid circuit	L-20-OV-24
L1	Filter choke	BBA-LGS5-24
R5, R10	Res., ww, 220 ohms ±3%, 7 w	DFR-22-117
R119	Res., film, 18,200 ohms ±1%, ¼ w	DCT-18-068
R124	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-048
T1	Transformer	ABA-LGS5C-24

MODEL LGS-5-28C-OV-R

C2	Cap., elect., 6,300 mf -10 +100%, 50 vdc	CBS-63-134
C112	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001
C127	Cap., mica, 100 pf ±5%, 500 vdc	CCJ-10-007
CR1, CR2	Rectifier	FBL-00-145
HC1	Hybrid circuit	L-20-OV-28
L1	Filter choke	BBA-LGS5-28
R5, R10	Res., ww, 250 ohms ±3%, 10 w	DFR-25-067
R119	Res., film, 20,000 ohms ±1%, ¼ w	DCT-20-053
R124	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-048
T1	Transformer	ABA-LGS5C-28

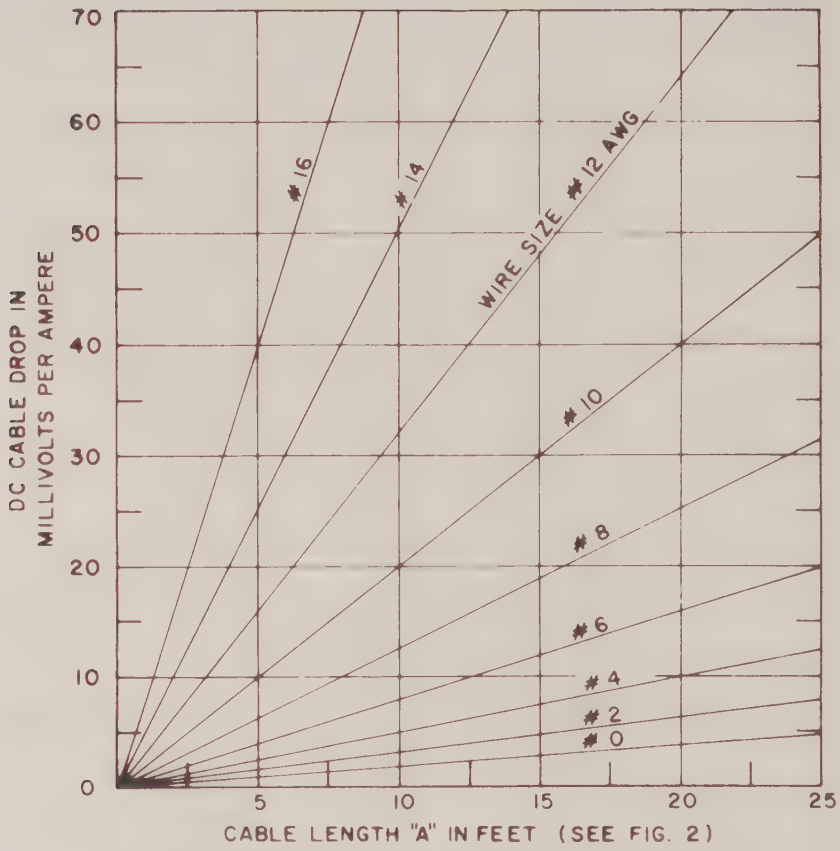


Figure 1. Cable Connection Chart

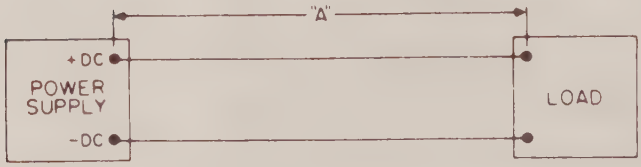


Figure 2. Cable Length "A" in Feet

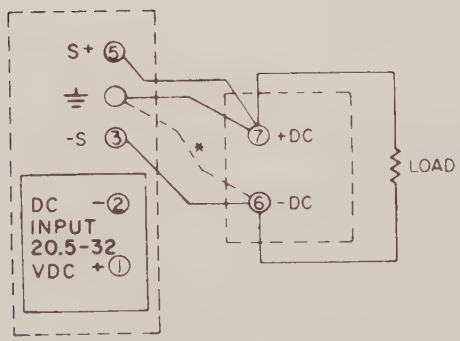


Figure 3. Local Sensing Connections

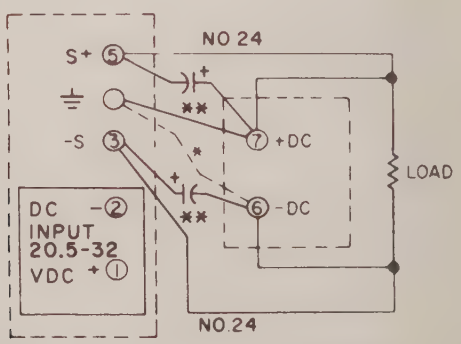


Figure 4. Remote Sensing Connections

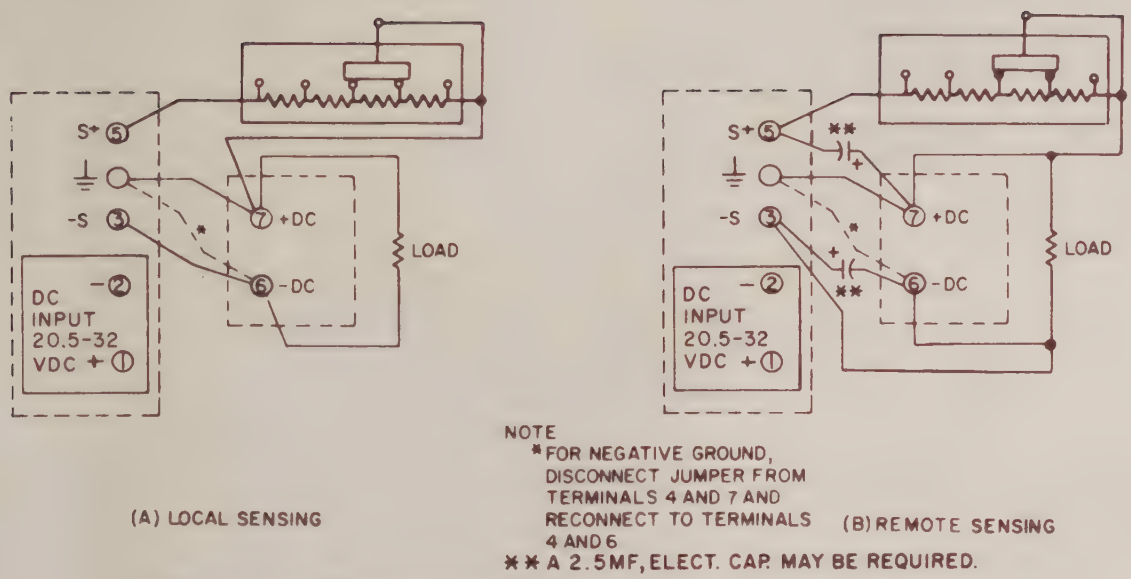


Figure 5. Programmed Voltage, with External Resistor

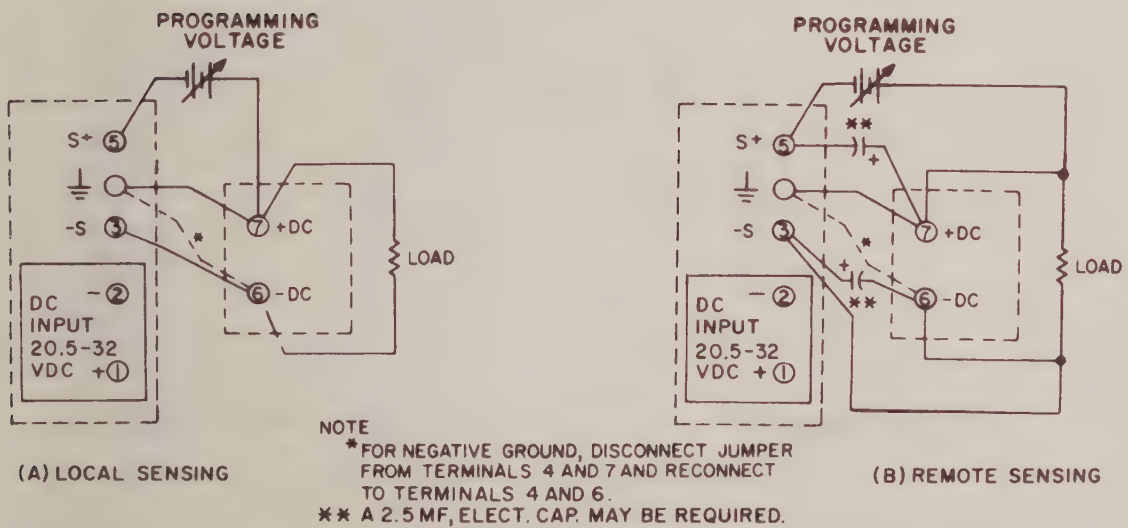
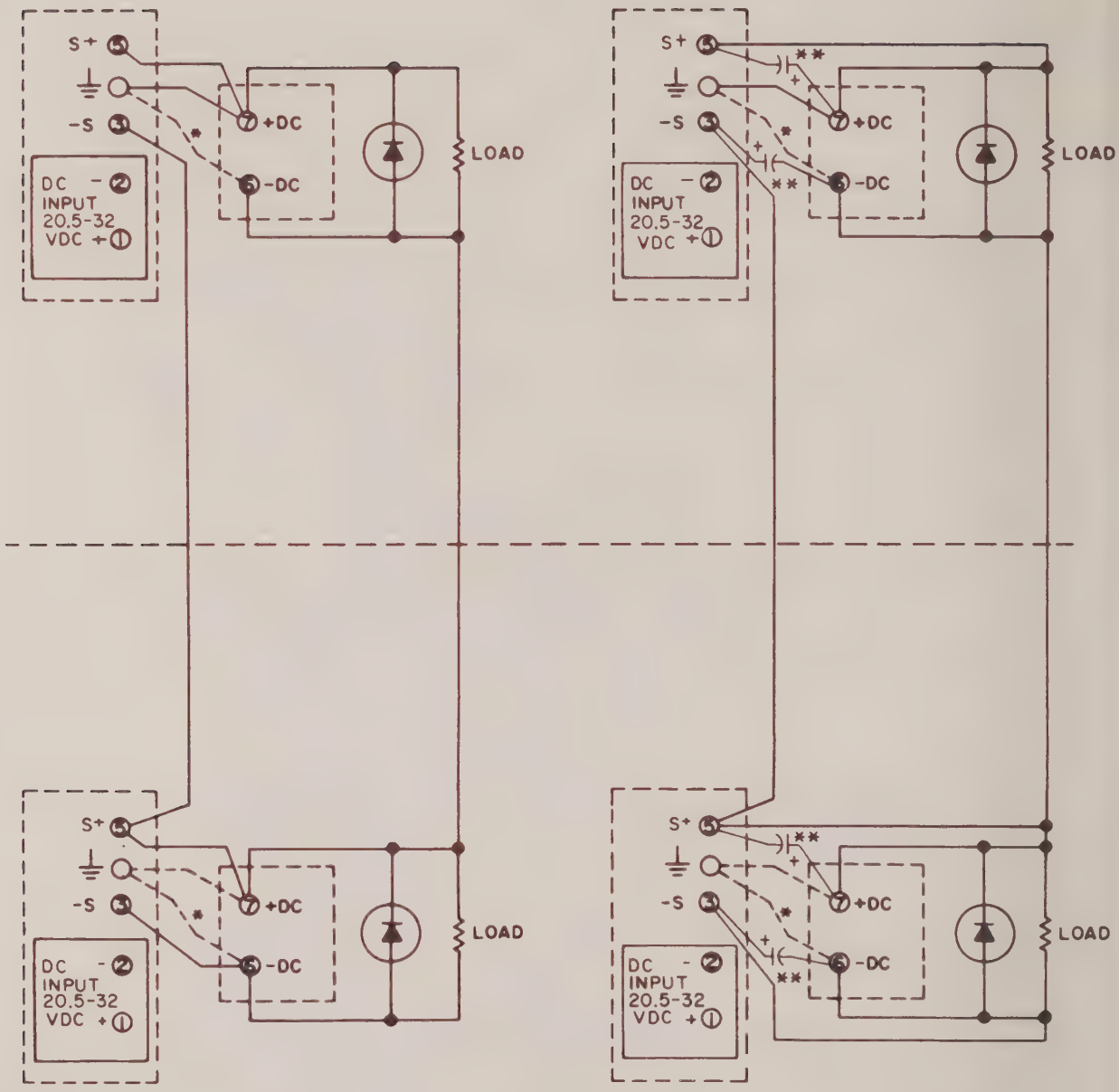


Figure 6. Programmed Voltage, with External Programming Voltage Source



NOTE:

* MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 4 AND 7 ON TOP UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5 MF, ELECT. CAP. MAY BE REQUIRED.

Figure 7. Series Connection

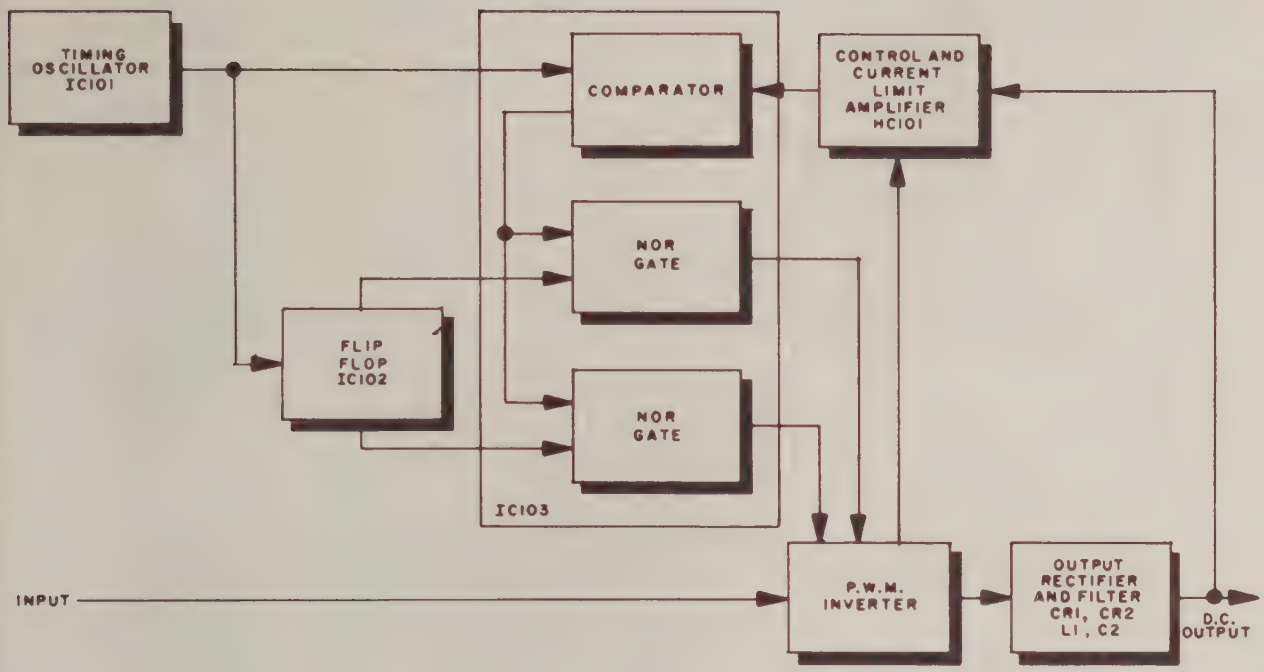


Figure 8. Typical Block Diagram

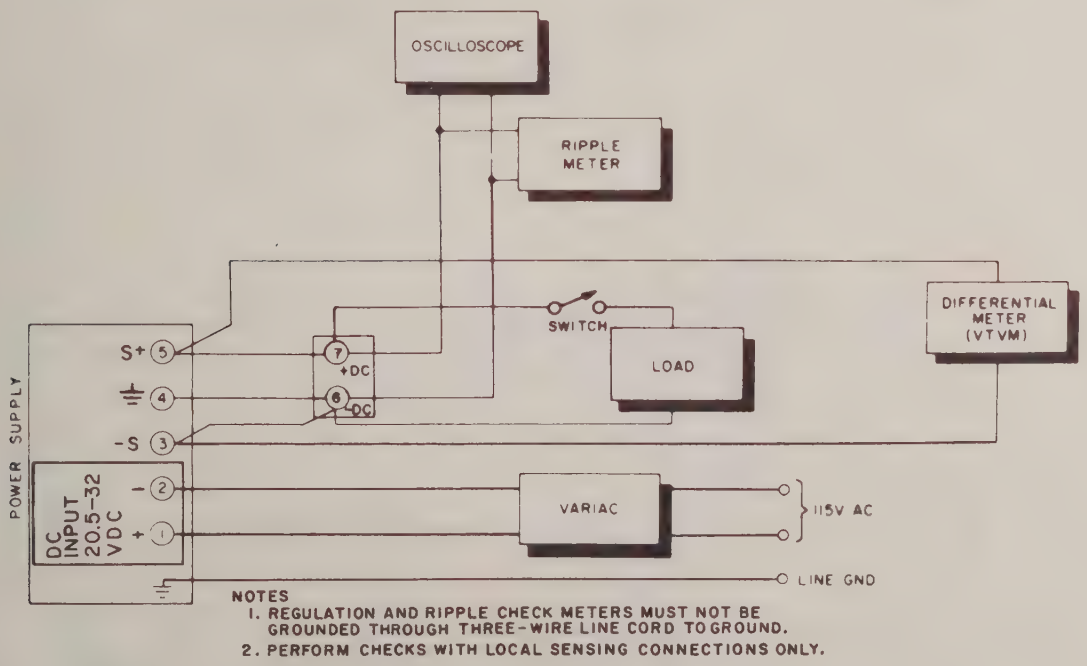


Figure 9. Test Connections for Performance Checks

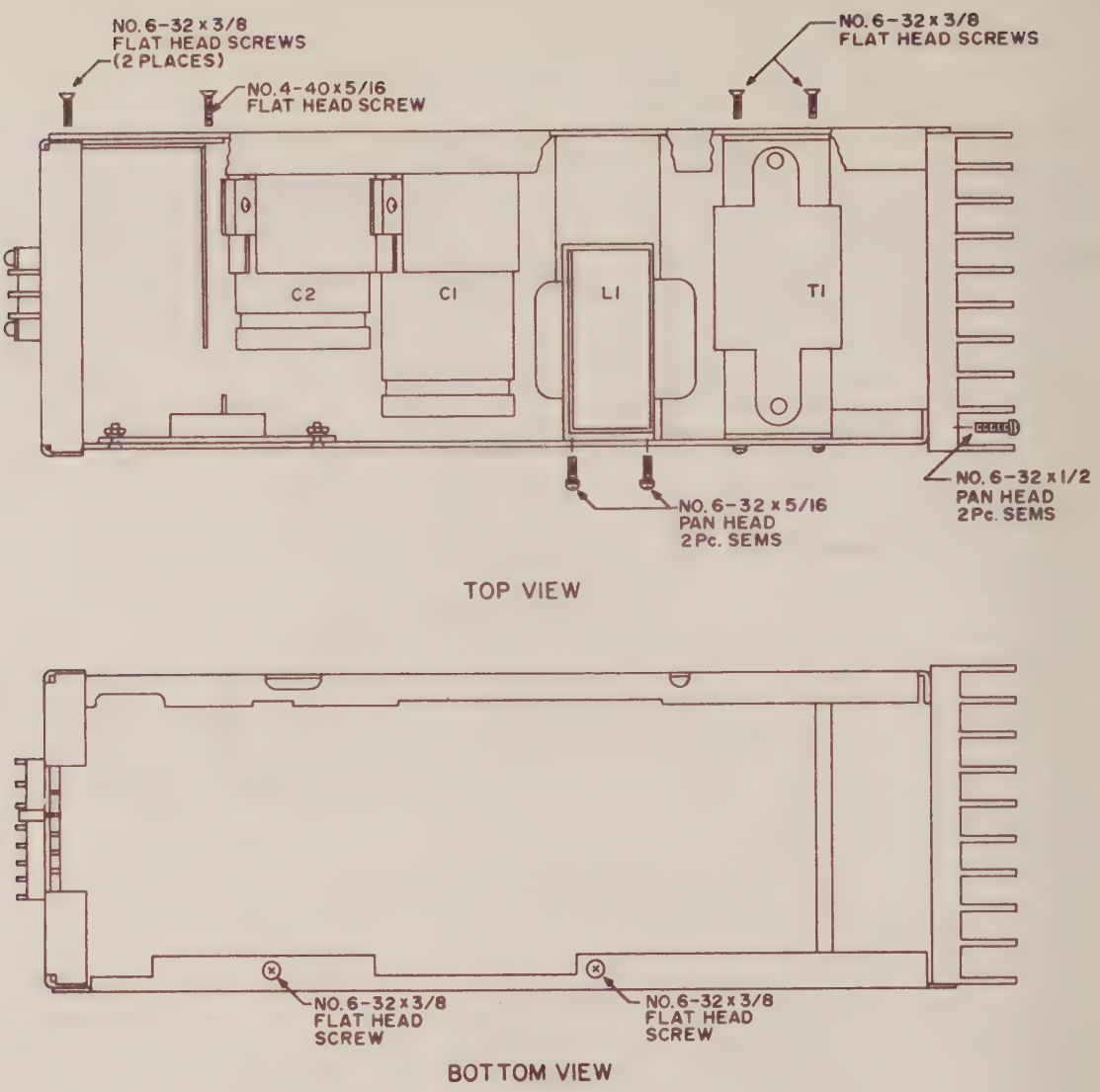


Figure 10. Opening for Trouble Shooting and Repair.

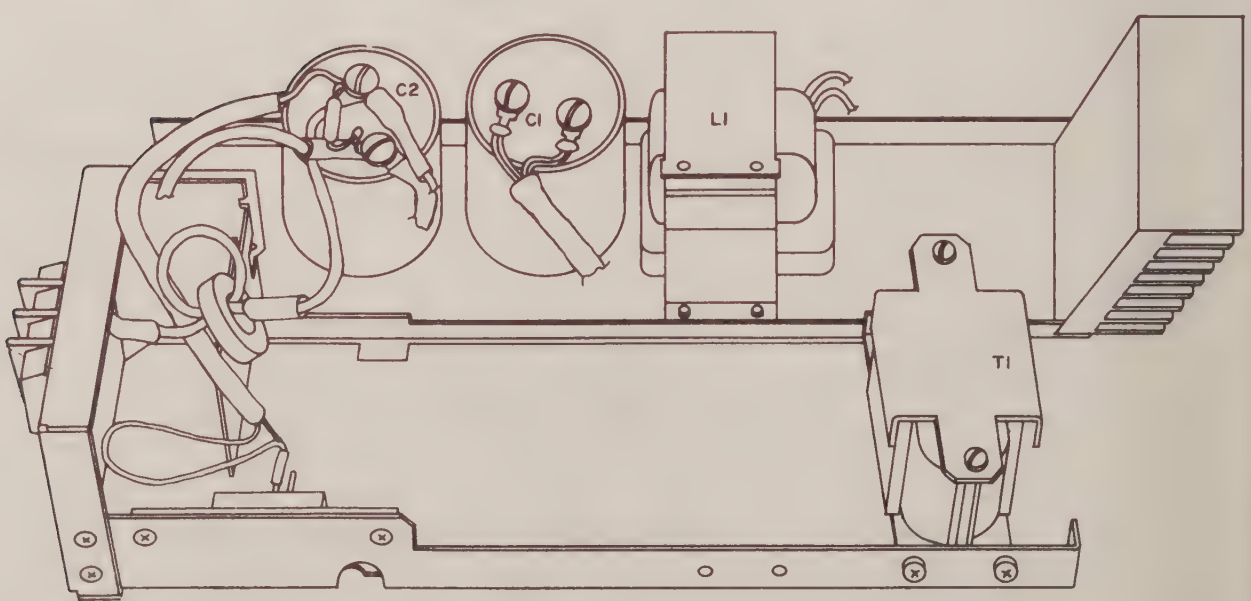
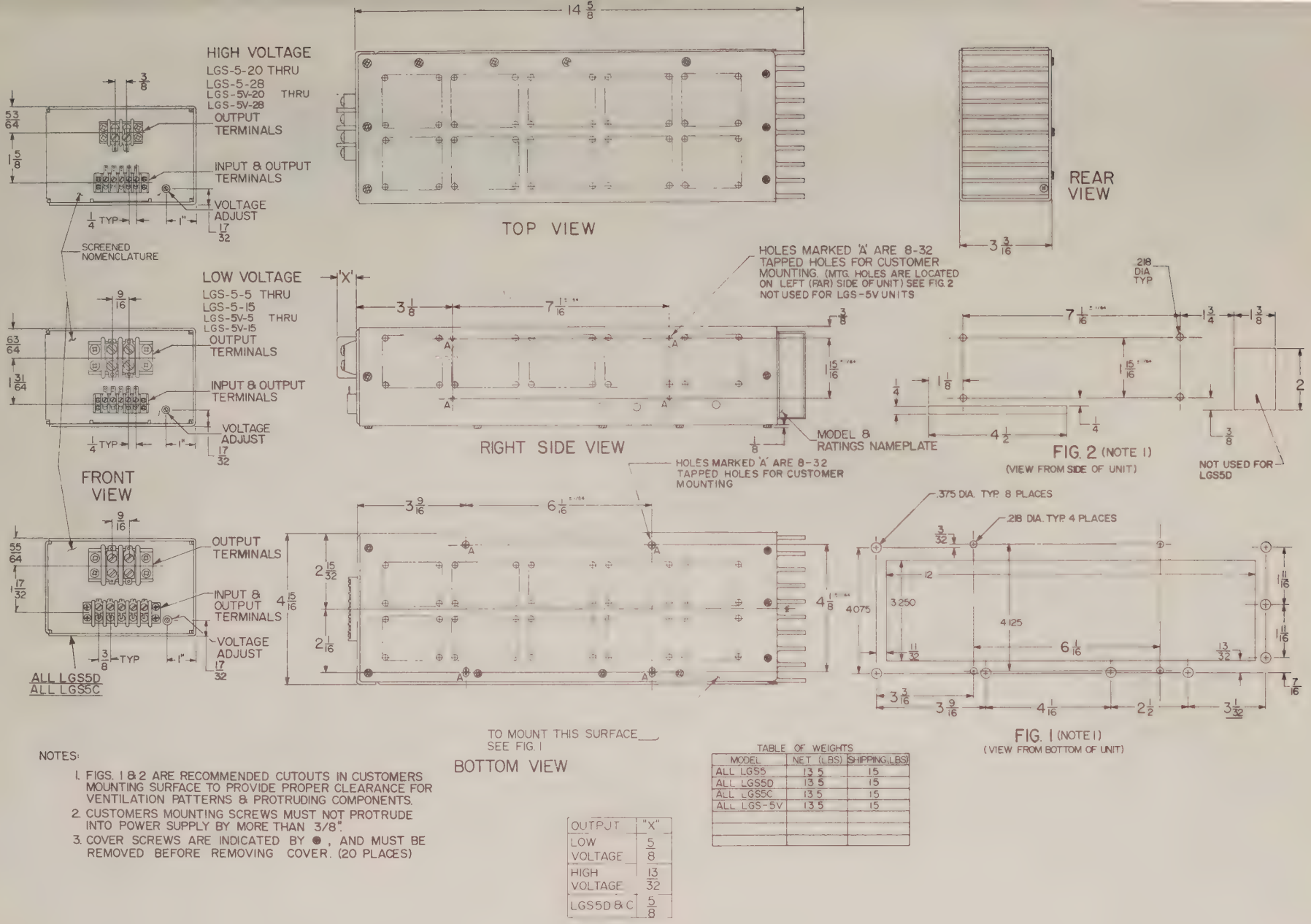


Figure 11. Open for Trouble Shooting and Repair.



NOTES:

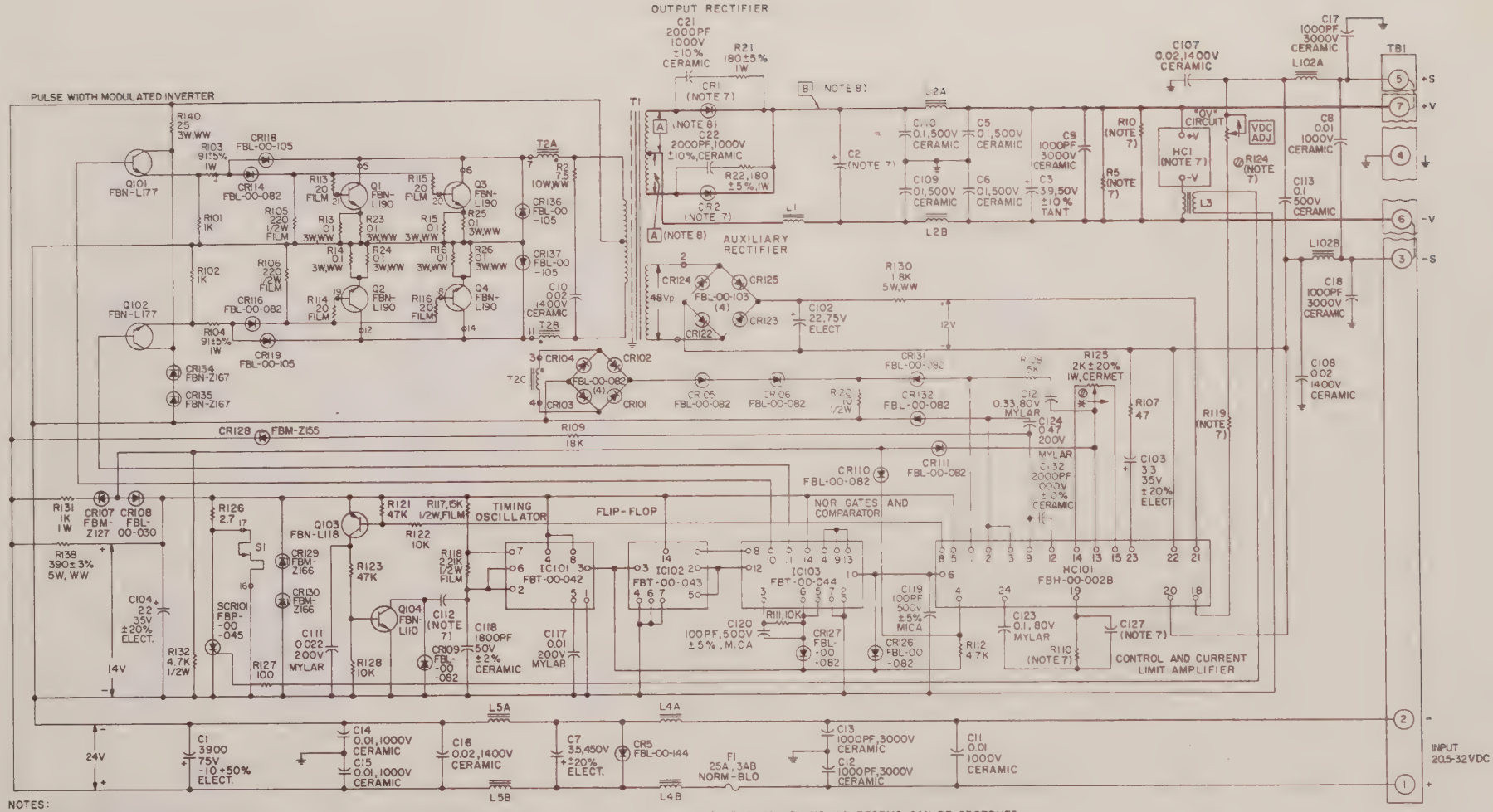
1. FIGS. 1 & 2 ARE RECOMMENDED CUTOUTS IN CUSTOMERS MOUNTING SURFACE TO PROVIDE PROPER CLEARANCE FOR VENTILATION PATTERNS & PROTRUDING COMPONENTS.
2. CUSTOMERS MOUNTING SCREWS MUST NOT PROTRUDE INTO POWER SUPPLY BY MORE THAN 3/8".
3. COVER SCREWS ARE INDICATED BY ⊛, AND MUST BE REMOVED BEFORE REMOVING COVER. (20 PLACES)

TABLE OF WEIGHTS

MODEL	NET (LBS)	SHIPPING (LBS)
ALL LGS5	13.5	15
ALL LGS5D	13.5	15
ALL LGS5C	13.5	15
ALL LGS-5V	13.5	15

OUTPUT	"X"
LOW VOLTAGE	5/8
HIGH VOLTAGE	13/32
LGS5D & C	5/8

Figure 12. Outline Drawing.

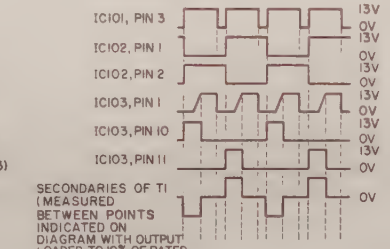


NOTES:

1. RESISTORS ARE 1/4W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP ± 10%, FILM ± 1%, WIREWOUND ± 5%.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10 + 100% CERAMIC ± 20%, MYLAR ± 10%, UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - * SEE INSTRUCTION MANUAL.
   - —o— INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.

⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.

6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. SEE TABLE I FOR COMPONENT VALUES.
8. SEE TABLE I FOR VOLTAGE VALUES.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 24 VDC. OUTPUT: NOMINAL VOLTAGE NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER, AC MEASUREMENTS ARE PEAK VALUES MEASURED WITH OSCILLOSCOPE. VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND -S (TERM. 3) UNLESS OTHERWISE NOTED.
10. THE FOLLOWING WAVEFORMS CAN BE OBSERVED BETWEEN INDICATED POINTS AND C1(-) UNLESS OTHERWISE NOTED:


IC101, PIN 3
IC102, PIN 1
IC102, PIN 2
IC103, PIN 1
IC103, PIN 10
IC103, PIN 11
SECONDARIES OF T1 (MEASURED BETWEEN POINTS INDICATED ON DIAGRAM WITH OUTPUT LOADED TO 10% OF RATED CURRENT MINIMUM)
13V
0V

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODELS
LGS-5-5C-0V-R
LGS-5-6C-0V-R
LGS-5-12C-0V-R
LGS-5-15C-0V-R
LGS-5-20C-0V-R
LGS-5-24C-0V-R
LGS-5-28C-0V-R

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-5-5C-OV-R THRU LGS-5-28C-OV-R

Models	Schematic Voltage Measurements		Schematic Components									
			C2	C112	C127	CR1, CR2	HC1	R10	R110	R119	R124	R5
	A (V_p)	B (VDC)	-10+100% ELECT.	±10% MYLAR	MICA	FBL-00-*	L-20-OV-*	WW	±10%, ¼ w COMP.	±1%, ¼ w FILM	1W CERMET	WW
LGS-5-5C-OV-R	12.0	5.0	45,000 mf 7.5 vdc	0.001 mf 400 vdc	680 pf ±10% 300 vdc	118	5	NOT USED	68K	Jumper	5K ±20%	25 ±3% 5W
LGS-5-6C-OV-R	14.4	6.0	45,000 mf 7.5 vdc	0.001 mf 400 vdc	680 pf ±10% 300 vdc	118	6	NOT USED	68K	Jumper	5K ±20%	25 ±3% 5W
LGS-5-12C-OV-R	28.0	12.0	19,000 mf 25 vdc	0.068 mf 200 vdc	680 pf ±10% 300 vdc	140	12	NOT USED	68K	7.5K	5K ±20%	50 ±3% 7W
LGS-5-15C-OV-R	32.0	15.0	15,000 mf 30 vdc	0.068 mf 200 vdc	680 pf ±10% 300 vdc	140	15	NOT USED	68K	10K	5K ±20%	75 ±3% 7W
LGS-5-20C-OV-R	40.0	20.0	10,000 mf 40 vdc	0.0068 mf 200 vdc	100 pf ±5% 500 vdc	145	20	220 ±3% 7W	100K	13.3K	10K ±10%	220 ±3% 7W
LGS-5-24C-OV-R	48.0	24.0	6,300 mf 50 vdc	0.0068 mf 200 vdc	100 pf ±5% 500 vdc	145	24	220 ±3% 7W	100K	18.2K	10K ±10%	220 ±3% 7W
LGS-5-28C-OV-R	56.0	28.0	6,300 mf 50 vdc	0.0068 mf 200 vdc	100 pf ±5% 500 vdc	145	28	250 ±3% 10W	100K	20K	10K ±10%	250 ±3% 10W

*Lambda part no.

5 - Year
Guarantee
We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.
We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS
515 BROAD HOLLOW ROAD • MELVILLE, L. I., NEW YORK • 516 MYRTLE 4-4200

MP MASTER
MA28359

DIVISION of Veeco INSTRUMENTS INC.

26141